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EXAMINER	
SHAH, UTPAL D	

ART UNIT	PAPER NUMBER
2625	

DATE MAILED: 06/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/087,772	Applicant(s) SUZUKI ET AL.	
	Examiner Utpal D. Shah	Art Unit 2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-17 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-17 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 05 March 2002 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 3/5/2002; 3/14/2005.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

The application has been examined.

Claims 1-17 are presented here for examination.

Claim Rejections - 35 USC § 112

Claims 8 and 11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 8 and 11 recite the limitation "said global evaluation condition" in last paragraph of the claims (see line 8). There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 7,10,13 and 16 are rejected under 35 U.S.C. 102(b) as being anticipated by an article published by Twaakyondo in Proceedings of 3rd International Conference on Document Analysis and Recognition, "Structure Analysis and Recognition of Mathematical Expressions." (Here on referred to as Twaakyondo).

In regards to claim 7, Twaakyondo discloses a mathematical expression recognizing device (Abstract, lines 1-5) comprising:

character recognition unit configured to recognize characters in a document image containing a text and a mathematical expression; a detecting unit configured to detect a mathematical expression region from the characters recognized by the character recognition unit: (page 431, left column, paragraph 3, Twaakyondo discloses detection of symbols or characters, which are eventually combined to detect a mathematical expression region.)

memory configured to store a plurality of items of sample information indicating a relation of normalization size and a center position between each pair of consecutively arranged characters in terms of the types of the characters including a horizontal positional relationship, character/subscript relationship and character/superscript relationship; and a unit configured to calculate the relation of the normalization size and the center position between each pair consecutively arranged characters included in the mathematical expression region and obtain link candidates for the horizontal positional relationships the character/subscript relationship and the character/superscript relationship based on the calculated relation of the normalization size and the center position and the sample information corresponding to the calculated relation of the types of the two consecutively arranged characters. (page 431, right column, paragraph 3, Twaakyondo discloses calculating normalized size and center position of symbols. Page 433, left column, paragraph 4, right column, paragraph 3, Twaakyondo discloses searching superscript and subscript expressions. Twaakyondo teaches using a search

region above or below target region to obtain relationship between consecutive symbols. The search region is based on the bounding box used to calculate normalization size and center position of each symbol. Twaakyondo further discloses in condition (d) that the symbol must be appropriate in contextual meaning. The examiner interprets this to mean that the device stores in memory sample information about the relationships between consecutive characters.)

3. Claims 10,13 and 16 recite limitations that are similar and in the same scope of invention as to those in claim 7 above in paragraph 2 and combinations thereof; therefore, claims 10,13 and 16 are rejected for the same rejection as described in claim 7.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. Claims 1,2,9,12 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over a article published by Garain in Proceedings of the 15th International Conference on Pattern Recognition, "A Syntactic Approach to Processing Mathematical Expression in Printed Documents" (Here on referred to as Garain) in view of article published by Srihari in Proceedings of the 13th International Conference on Artificial Intelligence, "Incorporating Syntactic Constraints in Recognizing Handwritten Sentences" (Here on referred to as Srihari.

In regards to claim 1, Garain discloses a mathematical expression recognizing (Abstract, lines 1-11) device comprising:

character recognition unit configured to recognize characters a document image containing a text and a mathematical expression; first dictionary configured to store a pair of evaluation scores for each type of word that can be identified by means of normal expression, the score showing the possibility of belonging to the text and that of belonging to the mathematical expression; (page 524, left side column, paragraph 4, Garain discloses to check each line to decide whether they contain one of the 25 frequently occurring math symbols. If the line contains one of the symbol than it is confirmed that line contains a math expression, otherwise it is text only line. A statistical study is done to detect the most frequent symbols. The examiner interprets this to mean that if one of the 25 symbols is detected than the character has a higher possibility of belonging to math expression than text. Hence giving it an evaluation score.)

an evaluation unit configured to obtain the evaluation scores showing the possibility of belonging the text and that of belonging to the mathematical expression for each of the words included in the characters recognized by the character recognition unit with reference to the first dictionary; and. (page 524, left column, paragraph 4, Garain discloses using a statistical survey to determine the 25 most frequently used math symbols, then using those symbols to determine whether a character belongs to text or math expression. The statistical survey gives each one of the 25 symbols an evaluation score.)

Garain does not expressly disclose a mathematical expression detecting unit configured to search for an optimal path connecting words by selecting one of the text and the mathematical expression based on a formative grammar and the evaluation scores showing the possibility of belonging to the text and that of belonging to the mathematical expression for each of the words, thereby detecting characters belonging to the mathematical expression.

However, Srihari discloses a mathematical expression detecting unit configured to search for an optimal path connecting words by selecting one of the text and the mathematical expression based on a formative grammar and the evaluation scores showing the possibility of belonging to the text and that of belonging to the mathematical expression for each of the words, thereby detecting characters belonging to the mathematical expression. (page 1264, right column, paragraph 5, Srihari discloses computing the best path among all possible sentences. To find the best path Srihari discloses using statistics and probabilities. The examiner notes that even though Srihari

does not expressly disclose method for recognition of math expression, it does teach to recognize characters (figure 2), which involved in recognizing math expressions.)

Garain & Srihari are combinable because they are from same field of endeavor i.e. character recognition. (Abstract, lines 1-5)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify Garain with the teachings of Srihari.

The motivation for doing so would have been to improve the accuracy of recognizing expressions. (page 1262, right column, paragraph 3)

Therefore, it would have been obvious to combine Garain with Srihari to obtain the invention as specified in claim 1.

7. In regards to claim 2, Garain and Srihari disclose all the claimed limitations of claim 1, as discussed above in paragraph 6 and incorporated herein by the reference.

Garain does not expressly disclose a mathematical expression detection unit comprising:

a second dictionary configured to store a connectable a part of speech and mathematical expression as the formative grammar; and a search unit configured to search for a path connecting the words and showing the largest evaluation score given to the word as the mathematical expression or the text out of all possible inter-word connection paths as the optimal path, by selecting either the text or mathematical expression for each word according to the part of speech of the word and the formative grammar read out from said second dictionary.

However, Srihari discloses a mathematical expression detection unit comprising:

a second dictionary configured to store a connectable a part of speech and mathematical expression as the formative grammar; (page 1264, right column, paragraph 4, Srihari discloses a lexicon (dictionary) the includes all the possible tags for the words and word probabilities. Tags for each word determine the grammar for the sentence.) and a search unit configured to search for a path connecting the words and showing the largest evaluation score given to the word as the mathematical expression or the text out of all possible inter-word connection paths as the optimal path, by selecting either the text or mathematical expression for each word according to the part of speech of the word and the formative grammar read out from said second dictionary. (page 1264, right column, paragraph 5, figure 4, Srihari discloses searching best path using the tag and word probabilities. In figure 4, Srihari discloses using words with the highest probabilities (evaluation score) to find the best path.)

Garain & Srihari are combinable because they are from same field of endeavor i.e. character recognition. (Abstract, lines 1-5)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify Garain with the teachings of Srihari.

The motivation for doing so would have been to improve the accuracy of recognizing expressions. (page 1262, right column, paragraph 3)

Therefore, it would have been obvious to combine Garain with Srihari to obtain the invention as specified in claim 2.

8. Claims 9,12 and 15 recite limitations that are similar and in the same scope of invention as to those in claim 1 above in paragraph 6 and combinations thereof; therefore, claims 9,12 and 15 are rejected for the same rejection as described in claim 1.

9. Claims 3,4,5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over a article published by Garain in Proceedings of the 15th International Conference on Pattern Recognition, "A Syntactic Approach to Processing Mathematical Expression in Printed Documents" (Here on referred to as Garain) and an article published by Srihari in Proceedings of the 13th International Conference on Artificial Intelligence, "Incorporating Syntactic Constraints in Recognizing Handwritten Sentences" (Here on referred to as Srihari, as applied to claim 1, further in view of an article published by Twaakyondo in Proceedings of 3rd International Conference on Document Analysis and Recognition, "Structure Analysis and Recognition of Mathematical Expressions." (Here on referred to as Twaakyondo).

In regards to claim 3, Garain and Srihari disclose all the claimed limitations of claim 1, as discussed above in paragraph 6 and incorporated herein by the reference.

Garain and Srihari do not expressly disclose a device further comprising: memory configured to store a plurality of items of sample information indicating a relation of a normalization size and a center position between each pair of consecutively arranged characters in terms of the types of the characters including a horizontal positional relationship, character/subscript relationship and character/superscript

relationship; and a determination unit configured to calculate the relation of the normalization size and the center position between each pair consecutively arranged characters included in the mathematical expression region and obtain link candidates for the horizontal positional relationships the character/subscript relationship and the character/superscript relationship based on the calculated relation of the normalization size and the center position and the sample information corresponding to the calculated relation of the types of the two consecutively arranged characters.

However, Twaakyondo discloses a device further comprising:

memory configured to store a plurality of items of sample information indicating a relation of a normalization size and a center position between each pair of consecutively arranged characters in terms of the types of the characters including a horizontal positional relationship, character/subscript relationship and character/superscript relationship; and a determination unit configured to calculate the relation of the normalization size and the center position between each pair consecutively arranged characters included in the mathematical expression region and obtain link candidates for the horizontal positional relationships the character/subscript relationship and the character/superscript relationship based on the calculated relation of the normalization size and the center position and the sample information corresponding to the calculated relation of the types of the two consecutively arranged characters. (page 431, right column, paragraph 3, Twaakyondo discloses calculating normalized size and center position of symbols. Page 433, left column, paragraph 4, right column, paragraph 3, Twaakyondo discloses searching superscript and subscript expressions. Twaakyondo

teaches using a search region above or below target region to obtain relationship between consecutive symbols. The search region is based on the bounding box used to calculate normalization size and center position of each symbol. Twaakyondo further discloses in condition (d) that the symbol must be appropriate in contextual meaning. The examiner interprets this to mean that the device stores in memory sample information about the relationships between consecutive characters.)

Garain, Srihari and Twaakyondo are combinable because they are from same field of endeavor i.e. recognition of expressions. (Abstract, lines 1-5)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify Garain and Srihari with the teachings of Twaakyondo.

The motivation for doing so would have been to improve the accuracy of recognizing expressions and produce more favorable results. (page 430, left column, paragraph 2)

Therefore, it would have been obvious to combine Garain and Srihari with Twaakyondo to obtain the invention as specified in claim 3.

10. In regards to claim 4, Garain, Srihari and Twaakyondo disclose all the limitations of claim 3, as discussed above in paragraph 9 and incorporated herein by the reference.

Garain and Srihari do not expressly disclose a device further comprising: memory configured storing condition for determined based on the of the heights of the characters mathematical expression region; and

select an inter-character structure candidate having a horizontal positional relationship, character/ subscript relationship or a character/superscript relationship for each pair of consecutively arranged characters based on said global evaluation condition and said link candidates and recognize the horizontal a global evaluation distribution contained in said positional relationship, the character/subscript relationship or the character/superscript relationship said pair of consecutively arranged characters based on the result of the search operation.

However, Twaakyondo discloses a device further comprising: memory configured storing global evaluation condition for determined based on the of the heights of the characters mathematical expression region; (page 433, right column, paragraph 3, Twaakyondo discloses conditions, which must be satisfied in order for the sub-expression (subscript or superscript) to be determined. The condition (c) teaches that the symbol in the subscript region cannot be larger than the target symbol.) and

select an inter-character structure candidate having a horizontal positional relationship, character/ subscript relationship or a character/superscript relationship for each pair of consecutively arranged characters based on said global evaluation condition and said link candidates and recognize the horizontal a global evaluation distribution contained in said positional relationship, the character/subscript relationship or the character/superscript relationship said pair of consecutively arranged characters based on the result of the search operation. (page 431, right column, paragraph 3, Twaakyondo discloses calculating normalized size and center position of symbols. Page 433, left column, paragraph 4, right column, paragraph 3, Twaakyondo discloses

searching superscript and subscript expressions. Twaakyondo teaches using a search region above or below target region to obtain relationship between consecutive symbols. The search region is based on the bounding box used to calculate normalization size and center position of each symbol. Twaakyondo further teaches a set of conditions which must be satisfied to determine a sub-expression.)

Garain, Srihari and Twaakyondo are combinable because they are from same field of endeavor i.e. recognition of expressions. (Abstract, lines 1-5)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify Garain and Srihari with the teachings of Twaakyondo.

The motivation for doing so would have been to improve the accuracy of recognizing expressions and produce more favorable results. (page 430, left column, paragraph 2)

Therefore, it would have been obvious to combine Garain and Srihari with Twaakyondo to obtain the invention as specified in claim 4.

11. In regards to claim 5, Garain, Srihari and Twaakyondo disclose all the limitations of claim 4, as discussed above in paragraph 10 and incorporated herein by the reference.

Garain and Srihari do not expressly disclose a device wherein said global evaluation condition comprises at least one of the relationship of the height of a character contained in a subscript region and the height of each of other characters, the positional relationship between a base line and a character contained in the subscript

region and the dispersion of heights among characters located on the same horizontal level.

However, Twaakyondo discloses a device wherein said global evaluation condition comprises at least one of the relationship of the height of a character contained in a subscript region and the height of each of other characters, the positional relationship between a base line and a character contained in the subscript region and the dispersion of heights among characters located on the same horizontal level. (page 433, right column, paragraph 3, Twaakyondo discloses conditions, which must be satisfied in order for the sub-expression (subscript or superscript) to be determined. The condition (c) teaches that the symbol in the subscript region cannot be larger than the target symbol. The condition (b) teaches that the symbol is the nearest symbol to the target symbol, hence showing the positional relationship.)

Garain, Srihari and Twaakyondo are combinable because they are from same field of endeavor i.e. recognition of expressions. (Abstract, lines 1-5)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify Garain and Srihari with the teachings of Twaakyondo.

The motivation for doing so would have been to improve the accuracy of recognizing expressions and produce more favorable results. (page 430, left column, paragraph 2)

Therefore, it would have been obvious to combine Garain and Srihari with Twaakyondo to obtain the invention as specified in claim 5.

12. In regards to claim 6, Garain, Srihari and Twaakyondo disclose all the limitations of claim 3, as discussed above in paragraph 9 and incorporated herein by the reference.

Garain and Srihari do not expressly disclose a decomposing unit configured to decompose each mathematical expression detected by said mathematical expression detection unit into components and remove at least left indexes, accent marks, root signs, and dots from each component, and wherein said determination unit obtains link candidates for the components from which the left indexes, accent marks, root signs, or dots is removed.

However, Twaakyondo discloses a decomposing unit configured to decompose each mathematical expression detected by said mathematical expression detection unit into components and remove at least left indexes, accent marks, root signs, and dots from each component, and wherein said determination unit obtains link candidates for the components from which the left indexes, accent marks, root signs, or dots is removed. (page 432, figure 1, Twaakyondo discloses decomposing the detected math expression into separate symbols like root signs, plus/minus signs.)

Garain, Srihari and Twaakyondo are combinable because they are from same field of endeavor i.e. recognition of expressions. (Abstract, lines 1-5)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify Garain and Srihari with the teachings of Twaakyondo.

The motivation for doing so would have been to improve the accuracy of recognizing expressions and produce more favorable results. (page 430, left column, paragraph 2)

Therefore, it would have been obvious to combine Garain and Srihari with Twaakyondo to obtain the invention as specified in claim 6.

13. Claims 8,11,14 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over a article published by Twaakyondo in Proceedings of 3rd International Conference on Document Analysis and Recognition, "Structure Analysis and Recognition of Mathematical Expressions." (Here on referred to as Twaakyondo) in view of an article published by Srihari in Proceedings of the 13th International Conference on Artificial Intelligence, "Incorporating Syntactic Constraints in Recognizing Handwritten Sentences" (Here on referred to as Srihari).

Twaakyondo discloses a mathematical expression recognizing device comprising: a character recognition unit configured to recognize characters in a document image containing a text and a mathematical expression; a detecting unit configured to detect a mathematical expression region from the characters recognized by the character recognition unit; (page 431, left column, paragraph 3, Twaakyondo discloses detection of symbols or characters, which are eventually combined to detect a mathematical expression region.)

a memory configured to store a plurality of items of sample information indicating a relation of normalization size and a center position between each pair of consecutively arranged characters in terms of the types of the characters including a horizontal positional relationship, character/subscript relationship and character/superscript relationship; a unit configured to calculate the relation of the normalization size and the

center position between each pair of consecutively arranged characters included in the mathematical expression region and obtain link candidates for the horizontal positional relationship, the character/subscript relationship and the character/superscript relationship based on the calculated relation the normalization size and the center position and the sample information corresponding to the calculated relation of the types of the two consecutively arranged characters; and (page 431, right column, paragraph 3, Twaakyondo discloses calculating normalized size and center position of symbols. Page 433, left column, paragraph 4, right column, paragraph 3, Twaakyondo discloses searching superscript and subscript expressions. Twaakyondo teaches using a search region above or below target region to obtain relationship between consecutive symbols. The search region is based on the bounding box used to calculate normalization size and center position of each symbol. Twaakyondo further discloses in condition (d) that the symbol must be appropriate in contextual meaning. The examiner interprets this to mean that the device stores in memory sample information about the relationships between consecutive characters.)

select an inter-character structure candidate having a horizontal positional relationship, a character/subscript relationship or a character/superscript relationship for each pair of consecutively arranged characters based on said global evaluation condition and said link candidates, and recognize the horizontal positional relationship, the character/subscript relationship or the character/superscript relationship of said pair of consecutively arranged characters based on the result of the search operation. (page 431, right column, paragraph 3, Twaakyondo discloses calculating normalized size and

center position of symbols. Page 433, left column, paragraph 4, right column, paragraph 3, Twaakyondo discloses searching superscript and subscript expressions. Twaakyondo teaches using a search region above or below target region to obtain relationship between consecutive symbols. The search region is based on the bounding box used to calculate normalization size and center position of each symbol. Twaakyondo further teaches a set of conditions which must be satisfied to determine a sub-expression.)

Twaakyondo does not expressly disclose a unit configured to search for an optimal path for connecting the characters in each of said mathematical expression regions without contradiction.

However, Srihari discloses a unit configured to search for an optimal path for connecting the characters in each of said mathematical expression regions without contradiction. (page 1264, right column, paragraph 5, Srihari discloses computing the best path among all possible sentences. To find the best path Srihari discloses using statistics and probabilities. The examiner notes that even though Srihari does not expressly disclose method for recognition of math expression, it does teach to recognize characters (figure 2), which involved in recognizing math expressions.)

Twaakyondo & Srihari are combinable because they are from same field of endeavor i.e. character recognition. (Abstract, lines 1-5)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify Twaakyondo with the teachings of Srihari.

The motivation for doing so would have been to improve the accuracy of recognizing expressions. (page 1262, right column, paragraph 3)

Therefore, it would have been obvious to combine Twaakyondo with Srihari to obtain the invention as specified in claim 8.

14. In regards to claim 14, Twaakyondo discloses a character recognizing unit configured to recognize characters in a document image containing a mathematical expression; a unit configured to detect a mathematical expression region from the outcome of character recognition obtained by said character recognizing means; (page 431, left column, paragraph 3, Twaakyondo discloses detection of symbols or characters, which are eventually combined to detect a mathematical expression region.)

a unit configured to store a plurality of pieces sample information on the inter-character relationship of the sizes of normalization and that of the center positions of each pair of consecutively arranged characters in terms of the types of the characters and positional relationships of horizontal positional relationship, an inter-character relationship determining unit configured to computationally determining the relationship of the sizes of normalization and that of the center positions of each all the pairs of consecutively arranged characters in a mathematical expression region and obtain link candidates as combinations of inter-character structure candidates showing the of having a horizontal positional relationship, a character/subscript relationship or a character/superscript relationship based on the result computation and sample information and their respective evaluation scores; (page 431, right column, paragraph

3, Twaakyondo discloses calculating normalized size and center position of symbols. Page 433, left column, paragraph 4, right column, paragraph 3, Twaakyondo discloses searching superscript and subscript expressions. Twaakyondo teaches using a search region above or below target region to obtain relationship between consecutive symbols. The search region is based on the bounding box used to calculate normalization size and center position of each symbol. Twaakyondo further discloses in condition (d) that the symbol must be appropriate in contextual meaning. The examiner interprets this to mean that the device stores in memory sample information about the relationships between consecutive characters.)

a unit configured to store a global evaluation condition based on the distribution of the heights of the characters contained said mathematical expression regions; and ; (page 433, right column, paragraph 3, Twaakyondo discloses conditions, which must be satisfied in order for the sub-expression (subscript or superscript) to be determined. The condition (c) teaches that the symbol in the subscript region cannot be larger than the target symbol.)

select an inter-character structure candidate having horizontal positional relationship, a character/subscript relationship or a character/superscript relationship for each pair of consecutively arranged characters, and recognize the horizontal positional relationship, the character/subscript relationship or the character/superscript relationship of said pair of consecutively arranged characters based on the result of the search operation. (page 431, right column, paragraph 3, Twaakyondo discloses calculating normalized size and center position of symbols. Page 433, left column,

paragraph 4, right column, paragraph 3, Twaakyondo discloses searching superscript and subscript expressions. Twaakyondo teaches using a search region above or below target region to obtain relationship between consecutive symbols. The search region is based on the bounding box used to calculate normalization size and center position of each symbol. Twaakyondo further teaches a set of conditions which must be satisfied to determine a sub-expression.)

Twaakyondo does not expressly disclose a unit configured to search for an optimal path for connecting the characters in each of said mathematical expression regions without contradiction.

However, Srihari discloses a unit configured to search for an optimal path for connecting the characters in each of said mathematical expression regions without contradiction. (page 1264, right column, paragraph 5, Srihari discloses computing the best path among all possible sentences. To find the best path Srihari discloses using statistics and probabilities. The examiner notes that even though Srihari does not expressly disclose method for recognition of math expression, it does teach to recognize characters (figure 2), which involved in recognizing math expressions.)

Twaakyondo & Srihari are combinable because they are from same field of endeavor i.e. character recognition. (Abstract, lines 1-5)

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify Twaakyondo with the teachings of Srihari.

The motivation for doing so would have been to improve the accuracy of recognizing expressions. (page 1262, right column, paragraph 3)

Therefore, it would have been obvious to combine Twaakyondo with Srihari to obtain the invention as specified in claim 14.

15. Claim 11 recite limitations that are similar and in the same scope of invention as to those in claim 8 above in paragraph 13 and combinations thereof; therefore, claim 11 is rejected for the same rejection as described in claim 8.

16. Claim 17 recite limitations that are similar and in the same scope of invention as to those in claim 14 above in paragraph 14 and combinations thereof; therefore, claim 17 is rejected for the same rejection as described in claim 14.

Conclusion

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Utpal D. Shah whose telephone number is 571-272-8568. The examiner can normally be reached on M-F (9 AM - 5:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on 571-272-7453. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306 (after July 15, 571-273-8300).

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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